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THE MEXICAN BEAN BEETLE IN THE EAST AND ITS CONTROL

THE MEXICAN BEAN BEETLE in its range of distribution is the most serious insect enemy of beans in the United States. It was first found in the East in Alabama in 1920, and now infests most of the States east of the Mississippi River.

The adult is a copper-colored beetle bearing 16 black spots on its back; it is about one-fourth of an inch long. The larva is orange colored and is frequently described as "fuzzy."

This insect feeds on the plants of all kinds of edible beans. The principal injury is done to the foliage.

For the control of this pest, derris or cubé powder in water, used as a spray, is most satisfactory. Cryolite also gives good results. Derris or cubé can be diluted with an inert carrier and used in dust form.

Infested fields should be plowed under as soon as the crop is off, and the grower should not plant more beans than can be properly treated.

This bulletin is a revision of and supersedes Farmers' Bulletin No. 1407, The Mexican Bean Beetle in the East.

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THE MEXICAN BEAN BEETLE IN THE EAST AND ITS CONTROL

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THE MEXICAN BEAN BEETLE[1] is the most serious insect enemy of beans in those parts of the United States which it inhabits. It has long been present in the Southwestern States. In 1920 it was discovered at Birmingham and Blocton, Ala. Since that time the pest has spread throughout the greater part of the territory east of the Mississippi River.

APPEARANCE OF INSECT AND NATURE OF DAMAGE

The Mexican bean beetle is a copper-colored, round-backed beetle with 16 black spots on its back. It is about one-fourth of an inch long and about one-fifth of an inch wide (fig. 1, *d*). The beetle resembles somewhat some of the native beneficial ladybirds.

The larva or immature form is orange-colored, varies in length from about one-twentieth of an inch when young to about one-third of an inch when full grown, and is covered with branched spines, which give it a fuzzy appearance.

Injury done by the young and adult of the Mexican bean beetle to the bean plant is different from that produced by other insects which feed on the beans. The adult, feeding from below, eats ragged areas in the lower surface of the leaf, but often cuts through the

[1] *Epilachna varivestis* Muls. (formerly *E. corrupta* Muls.); order Coleoptera, family Coccinellidae.

upper surface, giving the foliage a lacelike appearance (fig. 2). The larvae also feed on the under surface of the leaf, but do not

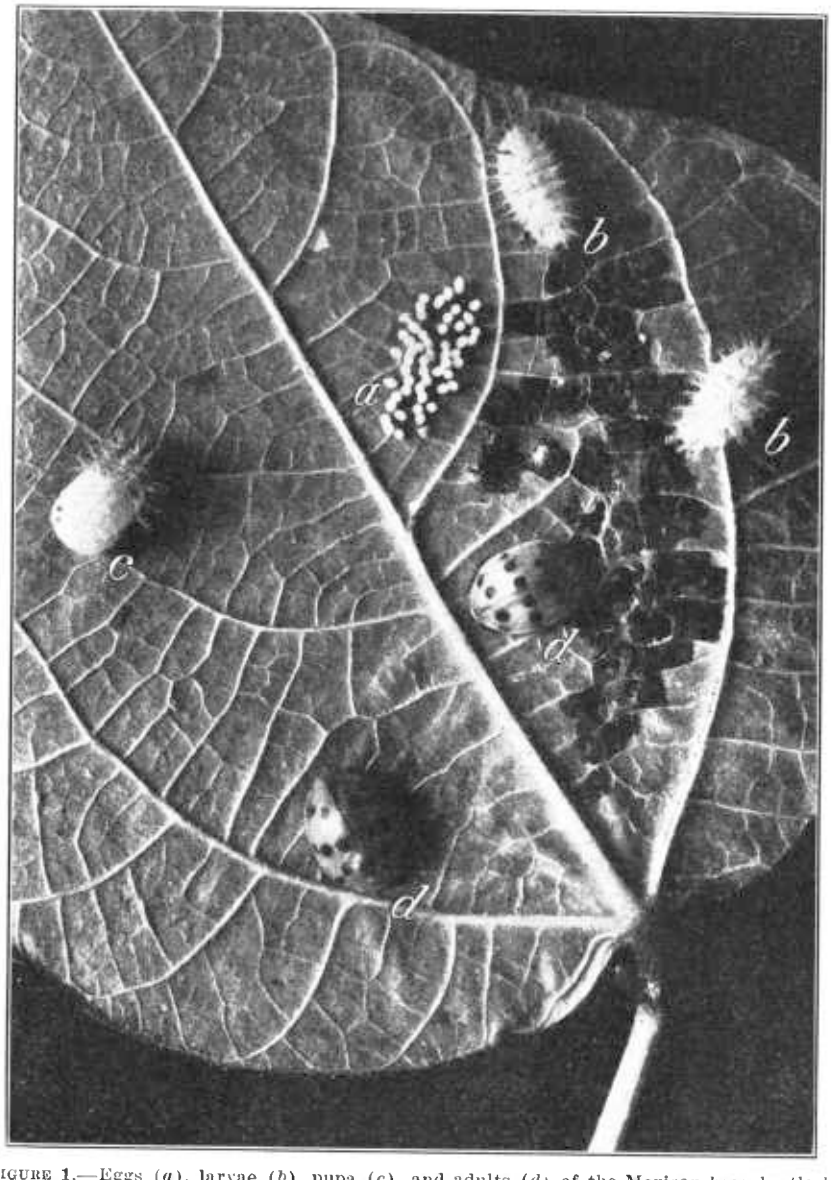

FIGURE 1.—Eggs (*a*), larvae (*b*), pupa (*c*), and adults (*d*) of the Mexican bean beetle in natural position on the under surface of a bean leaf. Enlarged three diameters.

cut through the upper surface. The lower tissue is cut away in narrow parallel sections about the length of the insect's body. Between these sections are narrow strips which are left untouched by

the larva, so that the result is a peculiar network characteristic of the work of this insect (fig. 3).

Although the leaves are attacked first, all parts of the plant above the ground may be fed upon by both beetle and larva. When the insects are numerous, an injured plant presents the appearance of being completely dried out (fig. 4). After destroying the leaves, the insect will attack the pods and even the stems.

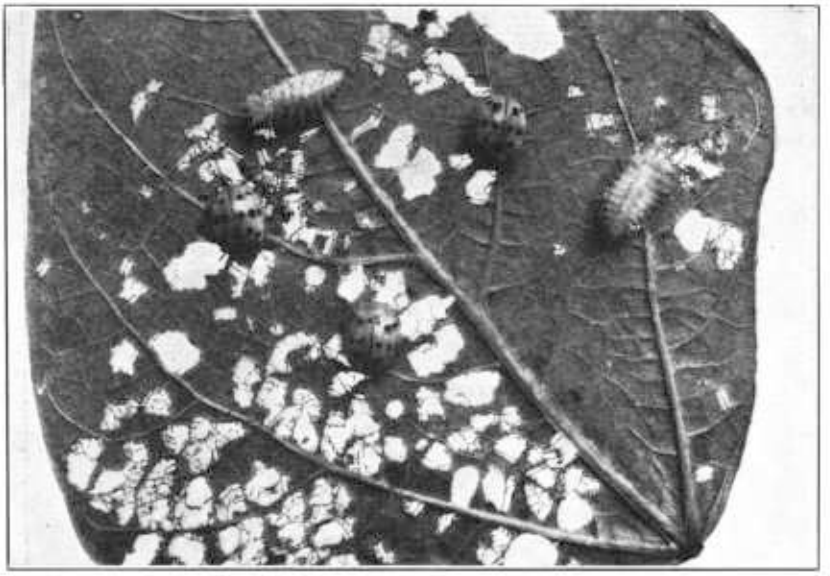

FIGURE 2.—Adults and larvae of the Mexican bean beetle on the under side of a bean leaf showing areas eaten by the adults. Enlarged two diameters.

When the beetles are abundant, a bean crop may be completely destroyed (fig. 5).

THE DIFFERENT STAGES

The Mexican bean beetle reproduces by means of eggs deposited in clusters of from 40 to 60 on the lower surface of a leaf. Figure 1 illustrates the different stages of the insect. The eggs are orange yellow. The young or larva, when first hatched, is about one-twentieth of an inch long, and a few hours after hatching it begins feeding. As it grows, the larva molts or sheds its skin. When full-grown it is about one-third of an inch long and about one-half as wide. The full-grown larva attaches itself to the under surface of the bean leaf upon which it has been feeding or to some other leaf, weed, or nearby object, and becomes shorter but larger around the body preparatory to pupation.

It then changes to the pupa or inactive stage, which is orange-colored, and is attached to the leaf or other object by means of the fourth larval skin. When the beetle develops from the pupal stage it is light-lemon colored and shows no black spots upon the wing

covers. The spots soon appear, however, and the beetle gradually becomes darker until after a week or 10 days it has become copper colored. Old beetles and those that have lived through the winter are darker in color, and the spots are less distinct.

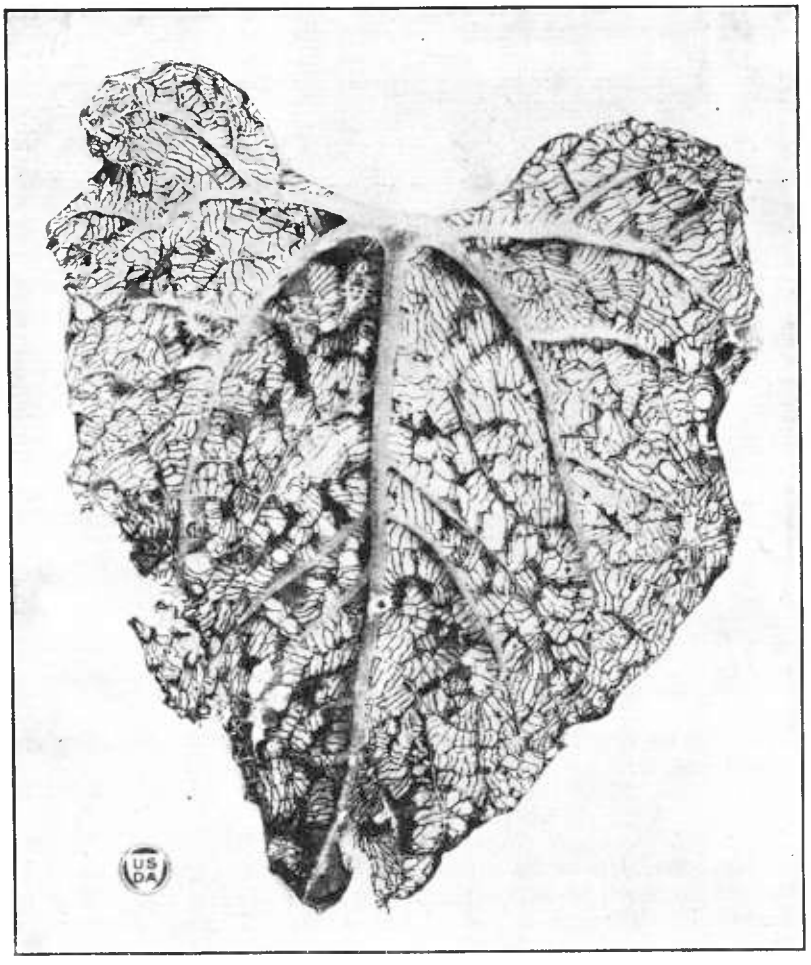

FIGURE 3.—The feeding of larvae of the Mexican bean beetle on a bean leaf. Slightly enlarged.

REGIONS IN WHICH THIS BEETLE IS FOUND

Probably the Mexican bean beetle came originally from Mexico. It has been known in the western part of the United States since about 1850. It is now known to exist in Arizona, New Mexico, Colorado, Wyoming, and Utah and has also been recorded from western Texas and western Nebraska.

In many districts of Colorado and New Mexico it is recognized as a very serious enemy of beans and one which has periodically caused heavy losses.

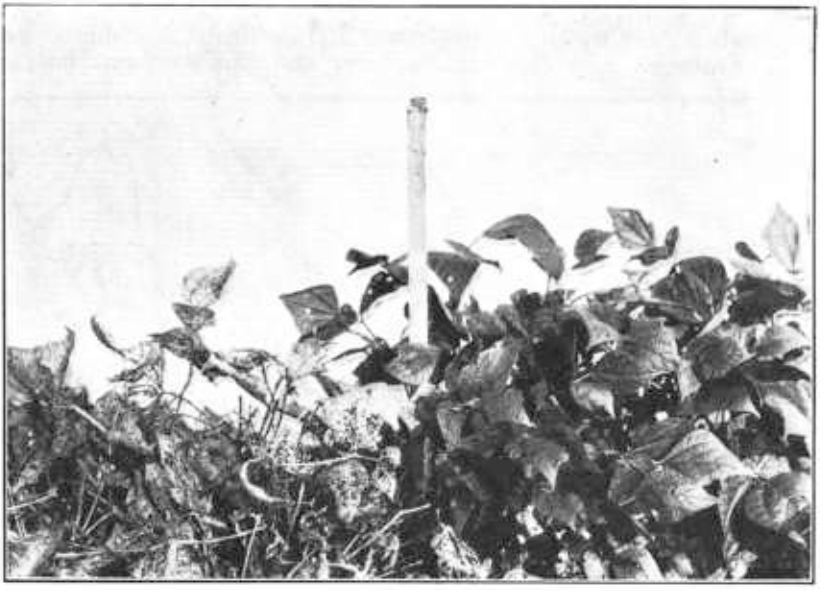

FIGURE 4.—Unsprayed beans to the left of stake; sprayed beans to the right.

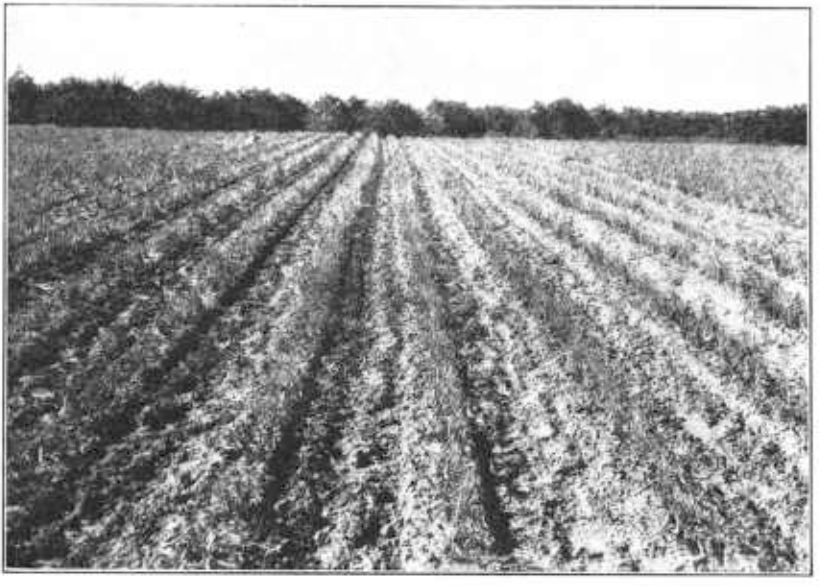

FIGURE 5.—A field of beans destroyed by the Mexican bean beetle.

Since its discovery in Alabama in 1920 it has spread to all the States east of the Mississippi River except Florida and Wisconsin. It extends as far north as the Lower Peninsula of Michigan, New York, Vermont, and New Hampshire, and the southern half of

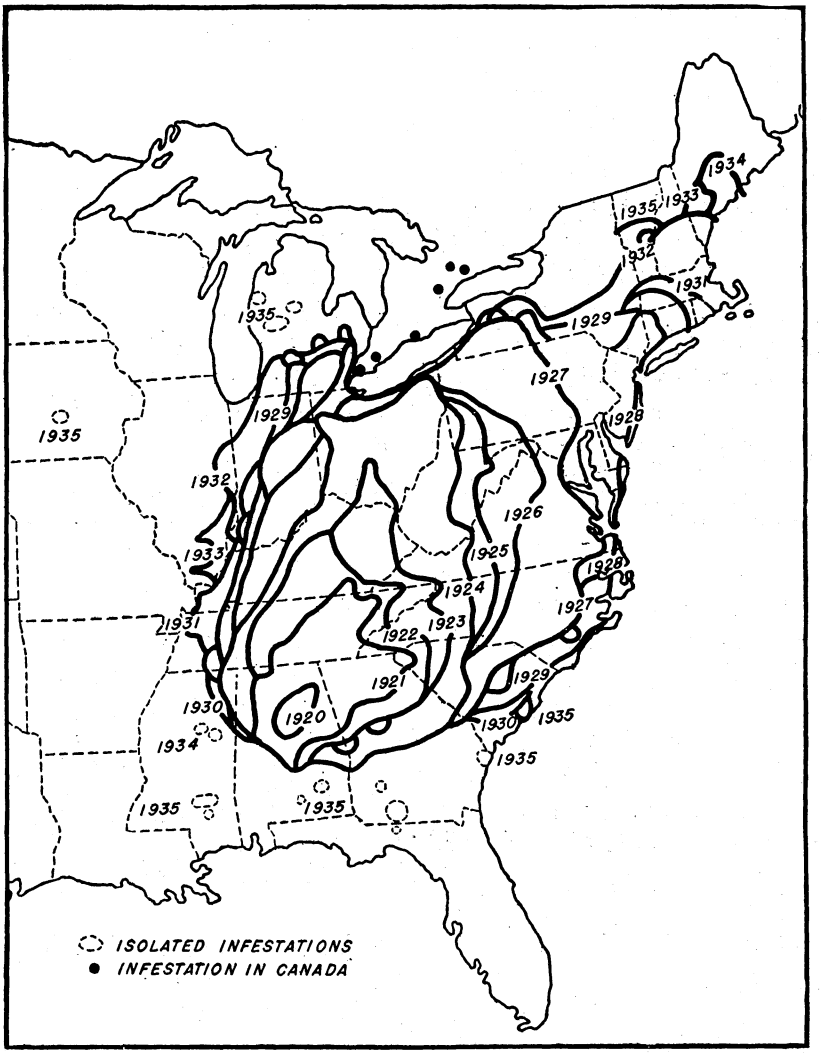

FIGURE 6.—Known distribution of the Mexican bean beetle in the Eastern States. The heavy lines represent the boundaries of infested territory for each year from 1920 to 1935, inclusive.

Maine, and also to the Province of Ontario, Canada, along the northern shores of Lake Erie and Lake Ontario (fig. 6). It has not proved to be a serious pest over all of this region, however. The worst damage has occurred in the area of the Allegheny Mountains and bordering foothills and valleys from northern Alabama and

Georgia to southern and eastern Ohio, Pennsylvania, and southern New England, as well as in eastern Virginia, Maryland, New Jersey, and Delaware. In 1933 an infestation in the vicinity of Minneapolis, Minn., was eradicated by State authorities. In Jefferson County, Fla., an infestation discovered in 1933 had disappeared the following year. During 1935 an isolated infestation in Jasper County, Iowa, was reported by authorities of that State. Recently (June 1936) a Mexican bean beetle was found in a Japanese beetle trap in St. Louis, Mo.

LIFE HISTORY AND HABITS

The beetles begin to leave their winter quarters in the spring. In the South they first appear in the bean fields late in March or early in April, while in southwestern New York they do not appear until June. At intermediate points they appear on different dates, depending on the location. In some places they are present when early beans are still small; in others, when the first blossoms appear. After feeding, usually for a week or 10 days, the females deposit their eggs.

Eggs laid early in the spring hatch in 10 to 14 days, as a rule. As the weather becomes warmer the eggs hatch in less time, in 6 or even 5 days. The young that hatch in the early part of the season develop rather slowly and may require 5 weeks to complete their growth. Later in the season, however, the development of the larvae requires an average of about 20 days. The pupal period during summer averages about 7 days. Thus the total period of development from egg to beetle averages about 33 days in midsummer.

Within 2 weeks after emerging from the pupa, the female beetle deposits eggs. Some beetles that overwintered may live for 3 months, but the majority die within 1 month. The insect reproduces rapidly; and by the time the early crop of beans has matured, the beetle has often become abundant. A maximum of three or even four generations of the beetle may occur in the Southern States, but in the North only one generation or one and a partial second are produced. In the Southwest one generation is the rule, but in some sections a second generation occurs.

The ability of the beetle to reproduce rapidly under favorable conditions is remarkable. A female may deposit an egg mass every 2 or 3 days. As many as 1,669 eggs have been deposited by one female, while the average number observed is 459.

Late in summer and early in fall the first beetles seek winter quarters, and others follow until about the first frost, at which time practically all beetles have left the fields. All stages are present in the field from spring until frosts in the fall, but eggs and larvae may become scarce late in the summer and early in the fall.

The spread from the original point of infestation in northern Alabama has been accomplished mainly by flight, with the assistance of prevailing winds. The beetle is sluggish in its movements, but is a comparatively strong flier and may fly many miles. Marked beetles have, within 2 days, been captured 5 miles from the point where they were liberated. During 1921 a spread of over 200 miles northward

occurred, and in 1922 a spread of over 100 miles, and the average maximum distance covered in the period 1921 to 1924 was 150 miles a year.

HIBERNATION

Only the adult beetle lives through the winter. In northern Alabama it hibernates preferably in woodlands near bean fields, where it often collects in small colonies. As many as 400 beetles have been found in one group covering an area of about 3 square feet, under pine needles and oak leaves on a well-drained woodland hillside near cultivated bean fields (fig. 7). Some may remain in the bean fields and others about the field or garden under rubbish and plant remnants and along fence rows and in uncultivated land. In many sections of the North and East the majority of the beetles hibernate in such places. The beetles have been found there in the winter as far as three-fourths of a mile from the nearest bean field, but the majority stay within a quarter of a mile. In the West the beetle may fly many miles to hibernate. In the Southeastern States complete dormancy is not continuous throughout the entire winter, since the beetles move about on warm days.

FOOD PLANTS

The Mexican bean beetle is primarily an edible-bean pest, preferring the common bean, such as snap (green or string), kidney, pinto, navy, and lima beans to other kinds. Its second choice of food is beggarweed (*Meibomia tortuosa* and *M. canescens*), or beggartick, which grows wild generally throughout the Eastern States and is cultivated for hay in some sections. The insect can reproduce successfully on cowpeas and soybeans, but injury to these crops is unusual.

NATURAL AGENCIES OF CONTROL

No internal parasite of the Mexican bean beetle had been recorded until 1922, when two native species of flies (*Phorocera claripennis* Macq. and *Helicobia helicis* Towns.) were found to parasitize the insect in rare instances in northern Alabama. They have never become abundant enough to be of any value.

A number of predacious insects feed on the eggs and young larvae, and in some cases on the older larvae, pupae, and adults of the Mexican bean beetle. The most common of these in the Southeastern States is the spotted ladybird (*Ceratomegilla fuscilabris* Muls.), which feeds sparingly on the eggs and young larvae. The "anchor bug" (*Stiretrus anchorago* F.) in both immature and adult stages preys on larvae, pupae, and adults of this bean beetle. The spined soldier bug (*Podisus maculiventris* Say) attacks all stages. A few other bugs and a few beneficial ladybird beetles feed on different stages of the bean beetle, but are of little importance. The adult bean beetle at times feeds on its own eggs.

A tachinid fly parasite (*Paradexodes epilachnae* Ald.) of this bean beetle is prevalent in some sections of Mexico, and efforts have been made to introduce the species into the United States but without success.

In the West the injury done by this pest to the bean crop has varied from year to year. This has been more or less true in the East, but in many sections the beetle has been sufficiently numerous every year to do serious injury and make the use of control measures necessary. No explanation for this fluctuation can be made other than that weather conditions are probably the most important factors. Heavy rains during the spring and summer are detrimental to the insect,

FIGURE 7.—Mexican bean beetle hibernating under pine needles and leaves in woods.

and larvae and adults often become mired in the soil. Extreme droughts and hot weather have been observed to act as a material check, especially if the beans suffer from lack of water. Temperature and moisture during the winter are important, and the survival during the winter depends largely on the effects of these factors.

The intense heat of bright sunlight during hot periods in summer kills many larvae and pupae. When dry weather causes the bean leaves to turn upward, or when varieties of beans which have this habit are grown, many egg masses, larvae, and pupae are exposed to the heat and killed.

CONTROL MEASURES

Where the Mexican bean beetle thrives, control measures are essential. The best-known remedy for the protection of beans is the appli-

cation of a spray containing derris-root powder, or cubé powder, or cryolite in water. A large number of other remedies have been tested extensively, but none of them has given as consistently good results as derris, cubé, or cryolite without injury to the plant. Derris-root powder, or cubé, mixed with talc, clay, or other diluent and applied as a dust, has given very good results and may be used when spraying is impractical.

SPRAYS RECOMMENDED

DERRIS OR CUBÉ

The recommended derris- or cubé-powder spray consists of 1½ pounds of the powder (containing 4 percent of rotenone) in 50 gallons of water; or, in smaller quantities, 1½ ounces in 3 gallons of water. This gives a rotenone content of approximately 0.015 percent in the spray. Derris or cubé powder of a different rotenone content may be used if the proper quantity is used to make a spray containing 0.015 percent of rotenone.

To calculate the quantity of derris or cubé to be used in 50 gallons of water when a certain percentage of rotenone is desired, divide the desired percentage by the rotenone content of the undiluted ground derris or cubé root, and multiply the result by the weight of 50 gallons of water at 59° F., (8.337 times 50) or 416.85. Thus if a derris or cubé powder of 4-percent rotenone content is on hand and a spray of 0.015-percent rotenone content is desired, the quantity to be used is approximately 1.56 pounds of derris or cubé to 50 gallons of water.

If the derris or cubé of 4-percent rotenone content is used, different quantities of spray may be prepared as follows:

To make 50 gallons of spray use 1½ pounds of the powder.
To make 3 gallons of spray use 1½ ounces (10 level tablespoonfuls or five-eighths of an 8-ounce measuring cup) of the powder.
To make 1 gallon of spray use one-half ounce, or 3 level tablespoonfuls, of the powder.

To prepare this spray, weigh the proper quantity of derris or cubé powder, then wet it thoroughly in a small quantity of water, and wash it through a fine strainer into the bulk of the water in the spray tank. Experiments have indicated that no spreader or sticker is necessary with derris, cubé, or cryolite for Mexican bean beetle control.

Derris or cubé sprays or dusts may be applied to beans after the pods have formed, if necessary, to stop damage by the bean beetle, since this compound should not leave harmful residues on the market product if applied at the strengths recommended herein.

Do not use for making up sprays the ready-mixed or home-mixed dusts containing 0.5 or 0.75 percent of rotenone which are intended for dusting and contain other materials. Only the undiluted ground root of derris or cubé plants should be used for making spray mixtures.

CRYOLITE

Cryolite (sodium fluoaluminate), either natural or synthetic, should be used in the proportion of 3 pounds in 50 gallons of water,

or at the rate of 3 ounces (9 level tablespoonfuls) in 3 gallons of water, or 1 ounce (3 level tablespoonfuls) in 1 gallon for small quantities.

See the warning regarding poisonous residues on page 17.

MAGNESIUM ARSENATE

For many years magnesium arsenate was the best insecticide obtainable for use against the Mexican bean beetle. During the last several years, however, this insecticide has caused serious injury to the bean plant under some conditions, and therefore cannot at the present time be considered a dependable insecticide for Mexican bean beetle control.

See the warning regarding poisonous residues on page 17.

SULPHUR

Sulphur is of value for controlling certain insects and diseases (see Dusts Recommended), and in instances where it is deemed necessary, wettable sulphur may be added to any of the sprays mentioned above at the rate of 2 pounds to 50 gallons of water.

WHEN TO APPLY THE SPRAY

Begin spraying when beetles are found in the field. If careful observations are made, spraying may be delayed until the eggs of the beetle become numerous, that is, when an egg group may be found on each 10 feet of row, or when the beetles are present in sufficient numbers to cause noticeable injury to foliage. To find eggs, look on the under sides of the leaves.

As the beans grow, the new foliage must be covered with the spray; therefore the treatment should be repeated at weekly or 10-day intervals, especially if the pest is abundant. Very often three or even four sprayings are necessary, but as a rule two thorough applications will be sufficient on snap beans. Growers of lima beans for market must necessarily protect the crop over a longer period.

HOW TO APPLY THE SPRAY

It is important that the sprays or dusts recommended in this bulletin for Mexican bean beetle control be applied on the under sides of the leaves, because the adults and larvae of this pest feed first on that part of the bean plant. Care should be taken to cover thoroughly with the insecticide the under sides of the leaves on all of the plants. Spraying or dusting only the upper surfaces of the leaves is practically useless and will not control the bean beetle.

SPRAY MACHINES

The grower of 4 or 5 acres of beans, or more, should use a horse-drawn power or traction spray machine, which will spray three to eight rows at a time. There is no entirely satisfactory sprayer available for small plantings of 1 or 2 acres, which are too large to be sprayed economically with a compressed-air or knapsack hand sprayer (fig. 8).

FIGURE 8.—Compressed-air sprayer with hose and extension to reach the under sides of the leaves.

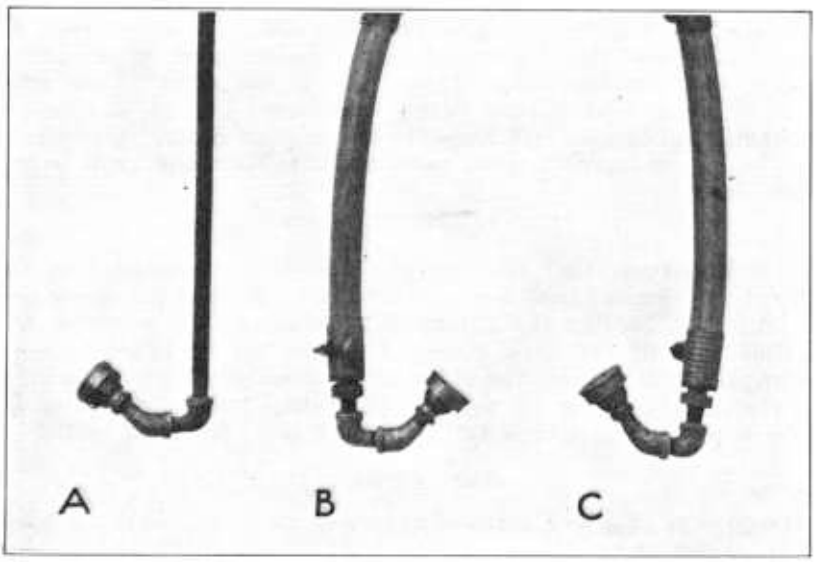

FIGURE 9.—Arrangement of nozzles necessary to spray the under sides of the leaves: *A*, For hand sprays; *B*, *C*, for power or traction sprayers, with hose sections to prevent breaking pipes.

Some growers have, however, used a barrel sprayer on a wagon bed or a two-wheeled cart for small plantings, arranging a boom and two nozzles to direct the spray to the under surfaces of the leaves. Such an arrangement requires the services of two men and hence is not very economical.

To reach the under surfaces of the leaves, the spray nozzles should be attached to the discharge pipe by a 90° elbow and a 45° elbow, as

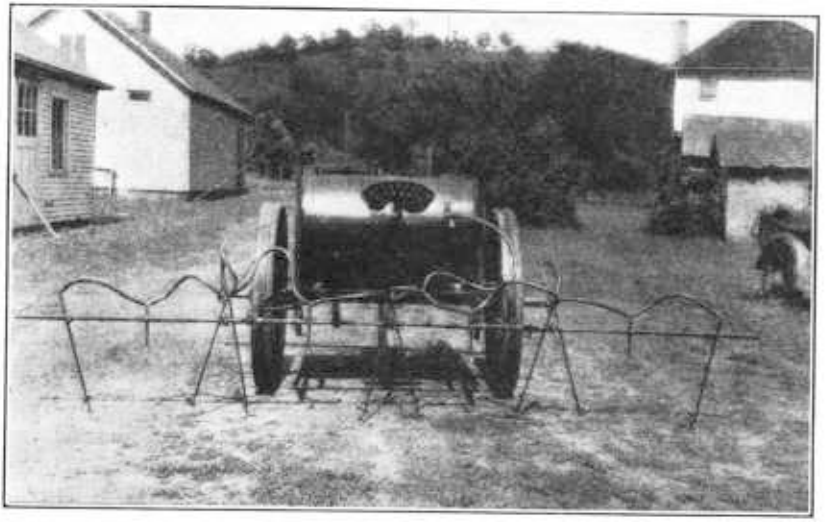

FIGURE 10.—Arrangement of nozzles and boom for spraying the under surfaces of the leaves. The nozzles are placed on rigid pipes, but the whole boom swings freely.

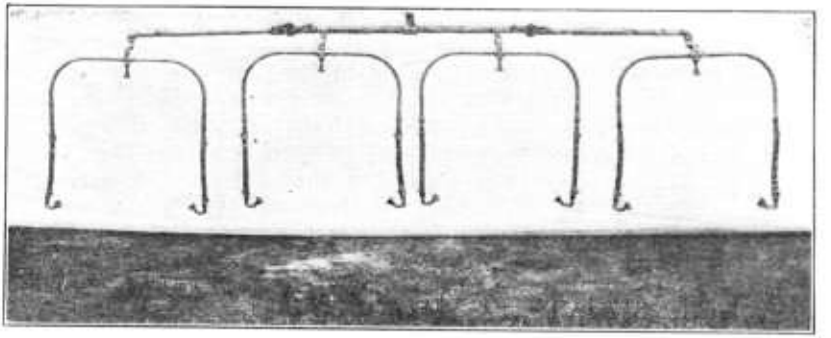

FIGURE 11.—A series of nozzles attached to a rigid boom. The boom and pipes are protected from breaking by the insertion of sections of rubber hose which bend on striking obstructions or on uneven ground.

shown in figure 9. When a power or traction machine is used it is well to have a third nozzle placed above the row (figs. 10 and 11).

The liquid must be agitated continuously so as to keep the insecticide from settling in the tank or sprayer.

A pressure of 150 pounds or more is necessary so as to blow the leaves about and insure thorough coverage. Pressure higher than 250 pounds is unnecessary.

New disks should be placed in the nozzles after a total of 10 to 15 hours of spraying. The holes in the disks become enlarged with use, and unless disks are replaced an unnecessary quantity of spray material is used.

The boom should be the proper width to suit the width of the rows, and all fields should be planted similarly so that no adjustment of nozzles will be necessary in spraying different fields.

In the case of young beans the boom should be lowered until the nozzles are about 2 inches above the ground. As the plants grow, the boom may be raised accordingly.

On uneven land it is well to have sections of rubber hose in the vertical outlet pipes, so as to make them flexible and thus prevent breaking of the pipes when passing over rough ground (figs. 9 and 11).

Under certain conditions, when a light or "spotted" infestation occurs on a large planting, it may not be necessary to spray the whole field. In such instances the isolated patches which show beetle or larval injury may be sprayed economically by one man with a 3- or 4-gallon compressed-air sprayer. In this manner the infestation may be so reduced as to save later crops from injury. Some growers have practiced this method with success. The nozzle should be arranged so as to spray the under sides of the leaves (fig. 9, *A*).

DUSTS RECOMMENDED

Sprays are recommended in preference to dusts for bean beetle control, since spraying will give better control and longer protection to the plants. However, the growers who prefer to dust or are not equipped to spray will obtain satisfactory results with the following dust mixtures.

Derris or cubé dusts of a rotenone content of 0.5 percent, either commercial or home-mixed, may be used when applied at the rate of 20 to 25 pounds to the acre per application. In the case of home-mixed dusts, either talc, dusting sulphur, infusorial earth, kaolin (china clay), or other finely ground inert clay, gypsum, diatomaceous earth, wheat flour, or tobacco dust may be used as a diluent or carrier, but recent experiments have indicated that talc is the most satisfactory. Dusting machines vary in their suitability for use with different materials. A grower may use the one of the carriers or diluents mentioned which is best suited to his machinery and most readily available to him at a reasonable price. Sulphur is of value in the control of the potato leafhopper (*Empoasca fabae* Harr.) on bean, and the common red spider (*Tetranychus telarius* L.), and for the prevention of powdery mildew; where any of these pests are present, sulphur is recommended in preference to other diluents. Sulphur also has value against the Mexican bean beetle, but when used with certain types of machinery it flows too freely, with the result that unnecessarily large dosages are applied. With careful attention and adjustments of the machinery, sulphur mixtures can usually be applied economically. Sulphur may be used alone as a carrier or in combination with one of the other materials mentioned above in any desired proportion.

To prepare a dust containing 0.5 percent of rotenone, use the following formula:

Derris or cubé powder (4 percent rotenone content)	12½ pounds (1 part by weight).
Talc or other diluent	87½ pounds (7 parts by weight).

If the rotenone content of the derris or cubé powder is greater or less than 4 percent, the quantity to be used in preparing a dust can be calculated as follows: Divide the percentage of rotenone desired in the finished dust by the rotenone content of the undiluted ground root and multiply the result by 100. This gives the number of pounds of undiluted derris or cubé to use in each 100 pounds of the mixture. Subtract this figure from 100 to obtain the number of pounds of carrier.

For instance, if a derris or cubé powder containing 5 percent of rotenone is used, 10 pounds of this and 90 pounds of diluent should be mixed to obtain a 0.50-percent rotenone dust. If it is desired to make a 0.75-percent rotenone dust from derris or cubé powder containing 5 percent of rotenone, 15 pounds of the 5-percent material should be mixed with 85 pounds of diluent.

Home-prepared dusts may be mixed thoroughly by putting the ingredients in a drum or barrel, not over two-thirds full, together with about a dozen stones as large as the fist, and rolling slowly and tilting at intervals for 5 minutes. Ready-prepared dusts may also be bought.

Cryolite used as an undiluted dust has given unsatisfactory results, but when used with fine dusting sulphur, wheat flour, or talc (60 pounds of cryolite to 40 pounds of the diluent), good results were obtained at times, whereas at other times the results were not satisfactory. In general, derris- or cubé-dust mixtures have given better results than cryolite and at lower cost.

See the warning regarding poisonous residues on page 17.

CALCIUM ARSENATE AND LEAD ARSENATE

Except in arid regions, plant injury often results from the use of certain calcium arsenate mixtures on beans. Consequently this material should not be used on beans in the East unless growers know that the material available will not injure the plants. In any case, hydrated lime should be used to aid in offsetting foliage injury. New types of calcium arsenate are being developed, and it may be that a calcium arsenate suitable for use on bean foliage will soon be available.

See the warning regarding poisonous residues on page 17.

Lead arsenate should never be used on bean foliage, because serious injury and reductions in yields often result from its use, even with bordeaux mixture.

HOW TO APPLY THE DUST

The dust should be directed to the under surfaces of the leaves and as much of the foliage as possible covered. Enough of the derris or cubé mixture should be applied so that about 2½ pounds of undiluted

ground root, calculated on 4-percent rotenone content, is applied to the acre. If a 0.5-percent rotenone content dust is used, this should be applied at the rate of 20 pounds to the acre, or if a dust with a greater rotenone content is used, less should be applied.

FIGURE 12.—A knapsack bellows duster in use.

DUSTING MACHINES

A dusting machine of some kind is essential in applying the dust. Applying the dust by the use of hand machines is at present easiest and most efficient with a knapsack type of duster equipped with a bean beetle nozzle (figs. 12 and 13). On small plantings a pump-type duster with a nozzle to direct the dust upward is very efficient and economical.

Traction or power machines for one or two horses are available equipped with nozzles (fig. 14) specially constructed to direct the dust to the under surfaces of the leaves. Recently New Jersey growers have obtained excellent results with reduced dosages of dusts by attaching hoods, one to the row, behind the duster to confine the dust and assure better covering of the foliage (fig. 15). These hoods may be constructed by taping bamboo poles, 10 feet long, to arches made from barrel hoops, and covering them with muslin.

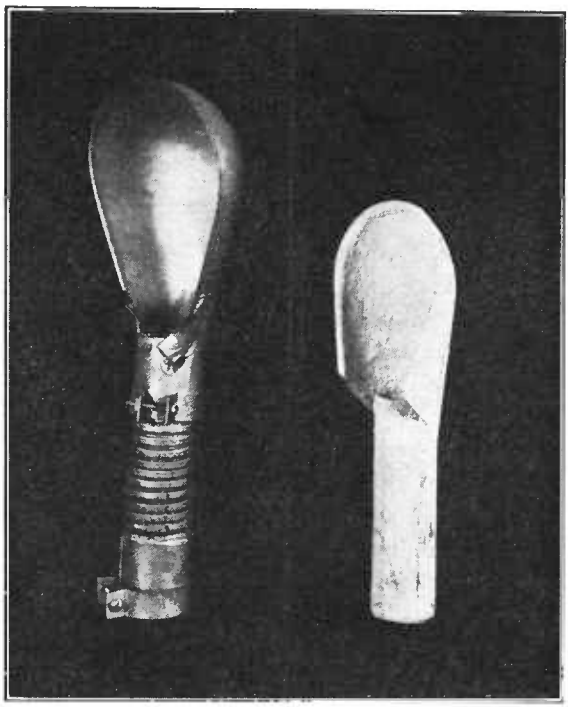

FIGURE 13.—Nozzles for use on dusting machines. The one at the right was made by attaching a grocer's scoop, after removing the handle, to a piece of metal tubing.

WARNING

Sprays or dusts containing fluorine or arsenicals, such as cryolite, calcium arsenate, or magnesium arsenate, should not be applied to beans after the pods begin to form.

Cryolite, calcium arsenate, and magnesium arsenate are poisonous to human beings and farm animals as well as to insects, and to avoid accidents care should be exercised in handling them. Since they are primarily stomach poisons, the hands should be washed after handling them, so as to prevent any possibility of getting these poisons into the stomach with food. Any cuts or broken skin on the hands or arms of the operator should be well bandaged to prevent the possibility of irritation from contamination by these insecticides.

WHERE TO GET THE INSECTICIDES

If the insecticides mentioned in this bulletin cannot be obtained from local dealers in agricultural supplies, from local seed stores,

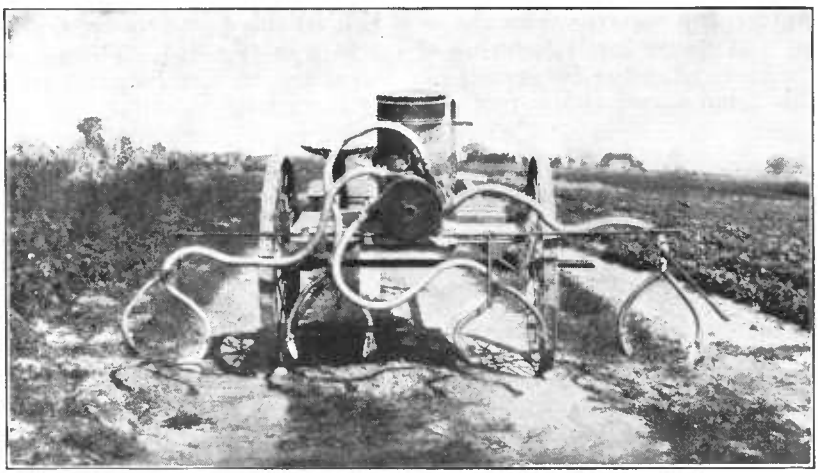

FIGURE 14.—A power duster mounted on a cart.

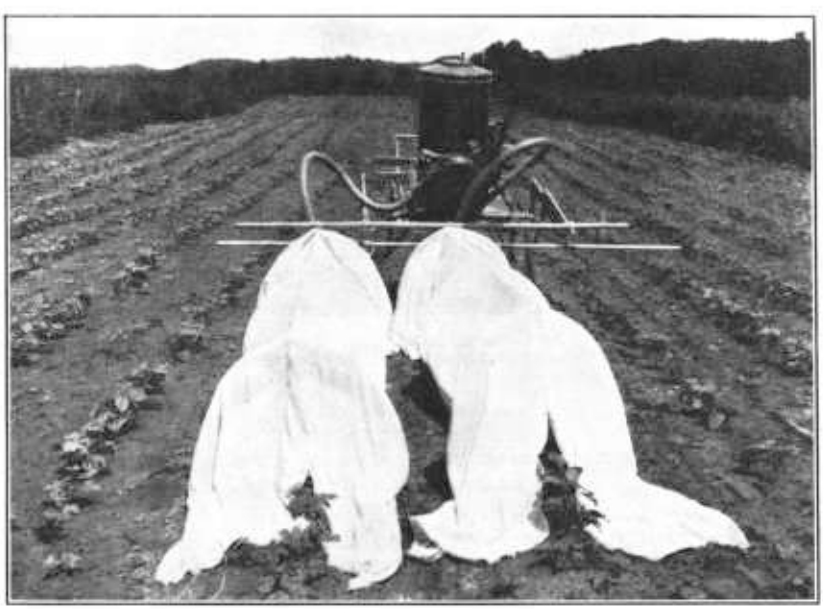

FIGURE 15.—Hoods or trailers constructed of bamboo poles and barrel hoops and covered with muslin.

or general stores, information regarding the nearest source of supply may be obtained by telephoning or writing to your county agent, State agricultural experiment station, or State department of agriculture.

PLOWING

As important as thorough spraying is the destruction of the crop remains after picking, especially in the case of snap beans. The fields should be plowed at least 6 inches deep, special effort being made to cover all the bean foliage. Under usual conditions a high percentage of all stages of the insect may be killed when thorough plowing is done.

There is reason to believe that the Mexican bean beetle could be so reduced in numbers by proper destruction of infested bean crops after harvest, over an area the size of an average county, that less spraying would be required. Benefits derived depend largely on the thoroughness of the disposition of crop remnants.

COMMUNITY COOPERATION

One of the important sources of infestation is the small garden in towns and settlements. A few untreated rows of beans in a neglected garden are often the breeding ground of many hundreds of beetles, which may spread to commercial acreages in the vicinity. In one locality in Virginia all garden beans in the neighborhood of large plantings are treated cooperatively. Many canners supply insecticides and hand sprayers to small growers at cost and give advice as to their use, and thus contribute to the control of the beetle to the benefit of the whole community. Similar assistance is given in many sections by the farm bureaus in cooperation with the county agent.

On the Eastern Shore of Maryland and Virginia heavy bean beetle damage usually occurs during July, August, and part of September. Normally large acreages of Fordhook and Henderson bush lima beans are planted, following various spring crops, and are available for food for the beetles during these months. Careful attention should be given to controlling the beetles on these plantings, as the beetles which matured on the spring crop of snap beans are usually flying about in search of food at this time, and young lima beans prove very attractive to them. These crops have a long growing season (being available for food for the beetle until frost); consequently a few untreated rows may be the source of many thousands of beetles that may spread to fall plantings of snap beans in the vicinity or breed large late-fall populations to enter hibernation.

CULTURAL PRACTICES

The date of planting snap beans to escape injury from the Mexican bean beetle is important in some sections, especially in instances where it is not necessary to have the crop mature at any certain time. No general rule can be made for all the Eastern States. In some sections beans planted very early escape serious injury. In other sections beans planted at the time when the overwintered adults are disappearing escape serious injury. This is the case in parts of southern Ohio, where beans planted the third week in June often mature without heavy damage because the overwintered beetles have almost disappeared by the time the beans are out of the ground and the beans are blossoming by the time the first brood of new adult beetles are numerous.

SUMMARY OF CONTROL MEASURES

The best control for the Mexican bean beetle is a spray containing ground derris root, or cubé root, or cryolite.

Derris or cubé powder having a rotenone content of 4 percent should be used at the strength of 1½ pounds in 50 gallons of water. Derris or cubé powder of a different rotenone content should be used in proportion to that content so as to make a spray containing 0.015 percent of rotenone. Cryolite should be used in the proportion of 3 pounds in 50 gallons of water.

The spraying must be done so thoroughly that the undersides of the leaves on all the plants are reached by the spray.

Begin spraying when the adults are found in the field or when the eggs of the beetle become numerous on the undersides of the leaves.

One to three, sometimes four, applications are required, depending on the abundance of the insect.

As important as thorough spraying is the destruction of the crop remains after harvest. Plow under all plant remnants at least 6 inches deep.

Dusting as a rule does not give as good results as spraying. A dust containing derris or cubé (4-percent rotenone) 12½ pounds, and talc, sulphur, clay or other diluent, 87½ pounds, may be used.

Cryolite or any arsenical should not be applied to beans after the pods begin to form.

Lead arsenate should not be used on beans, since plant injury may result from its use.

Fluorine and arsenical insecticides are poisonous. Handle them carefully and avoid accidents.

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